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**McGuire et al.**

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(54) **AUTOMATED OPTICAL DIMENSIONING AND IMAGING**

(71) Applicant: **Amazon Technologies, Inc.**, Reno, NV (US)

(72) Inventors: **Jonathan G. McGuire**, Seattle, WA (US); **Sarah D. Benjamin**, Seattle, WA (US); **Sunil Ramesh**, San Jose, CA (US); **Peter D. Rowley**, Sammamish, WA (US); **Matthew Warren Amacker**, Santa Clara, CA (US)

(73) Assignee: **Amazon Technologies, Inc.**, Seattle, WA (US)

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(51) **Int. Cl.**

| | |
|---|---|
| ***H04N 13/02*** | (2006.01) |
| ***G01B 11/24*** | (2006.01) |
| ***G03B 15/06*** | (2006.01) |
| ***G03B 17/56*** | (2006.01) |
| ***G06Q 30/06*** | (2012.01) |

(52) **U.S. Cl.**
CPC ..... ***G01B 11/24*** (2013.01); ***G03B 15/06*** (2013.01); ***G03B 17/561*** (2013.01); ***G06Q 30/0601*** (2013.01); ***G06Q 30/0643*** (2013.01)

(58) **Field of Classification Search**
CPC ... G01B 1/241; H04N 13/0221; G01M 3/3209
USPC ..... 348/46; 73/52
See application file for complete search history.

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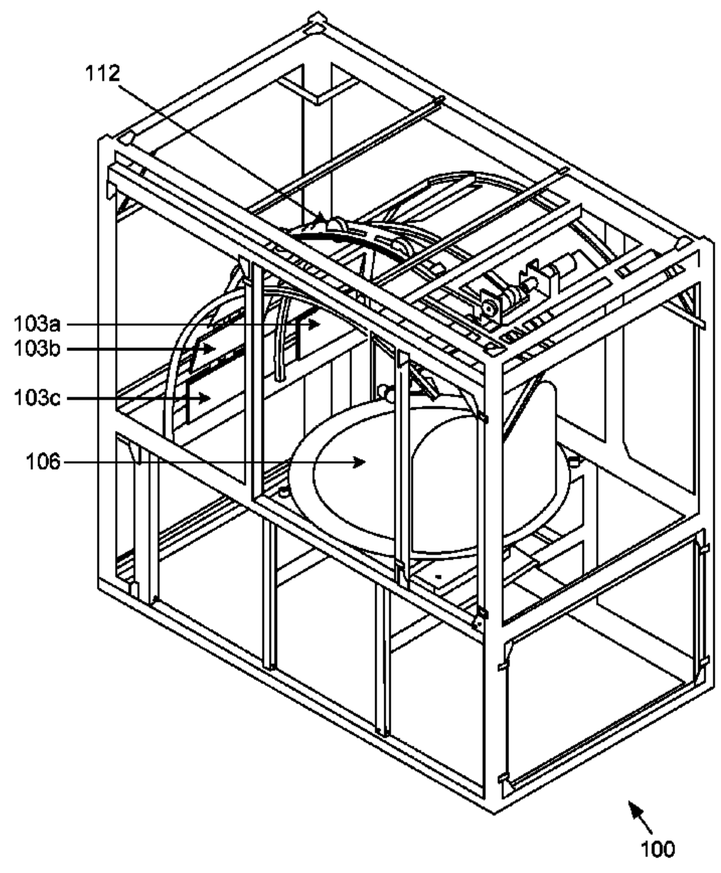
*Primary Examiner* — Tat Chio
*Assistant Examiner* — Masum Billah
(74) *Attorney, Agent, or Firm* — Thomas | Horstemeyer, LLP

(57) **ABSTRACT**

Disclosed are various embodiments for automatically generating media and/or data associated with an item. An item imaging apparatus may apply an imaging sequence based on an item being imaged to gather media and/or data associated with the item. The media and/or data associated with the item may be used in the generation of additional data associated with the item. The media and/or data may be in a profile of the item in an electronic marketplace.

**26 Claims, 11 Drawing Sheets**



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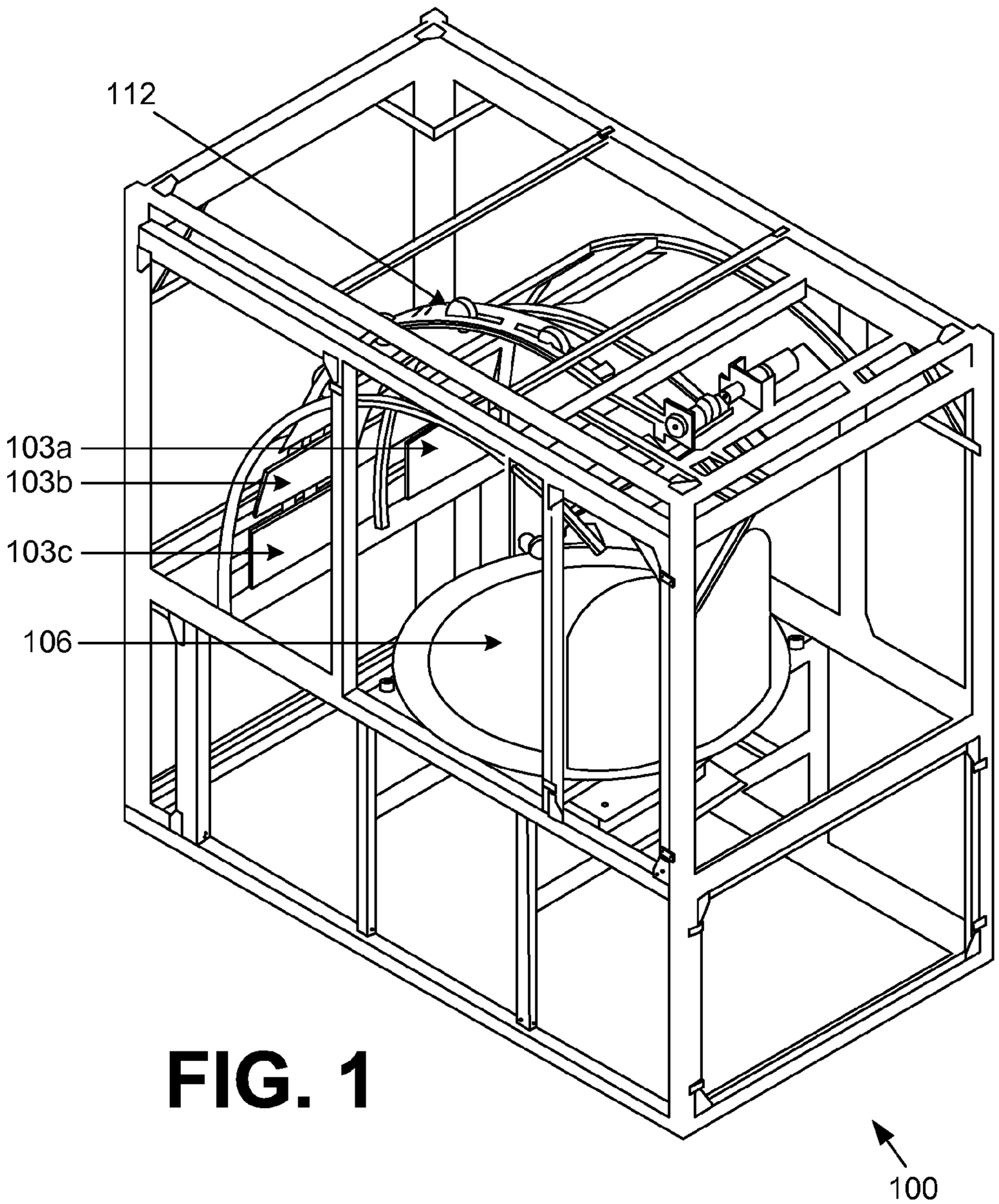


FIG. 1

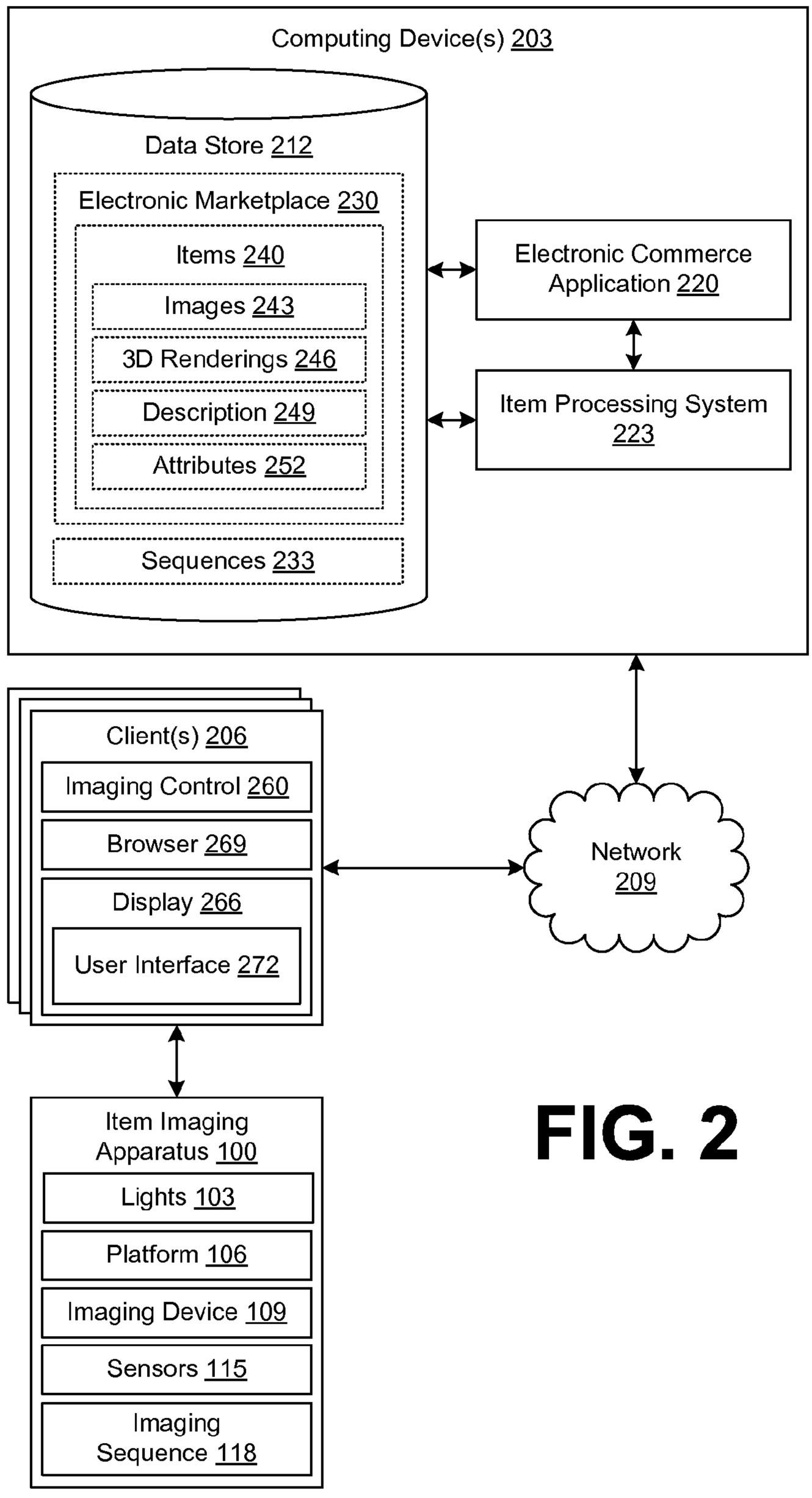
Computing Device(s) 203
Data Store 212
Electronic Marketplace 230
Items 240
Images 243
3D Renderings 246
Description 249
Attributes 252
Sequences 233
Electronic Commerce Application 220
Item Processing System 223
Client(s) 206
Imaging Control 260
Browser 269
Display 266
User Interface 272
Network 209
Item Imaging Apparatus 100
Lights 103
Platform 106
Imaging Device 109
Sensors 115
Imaging Sequence 118
200

FIG. 2

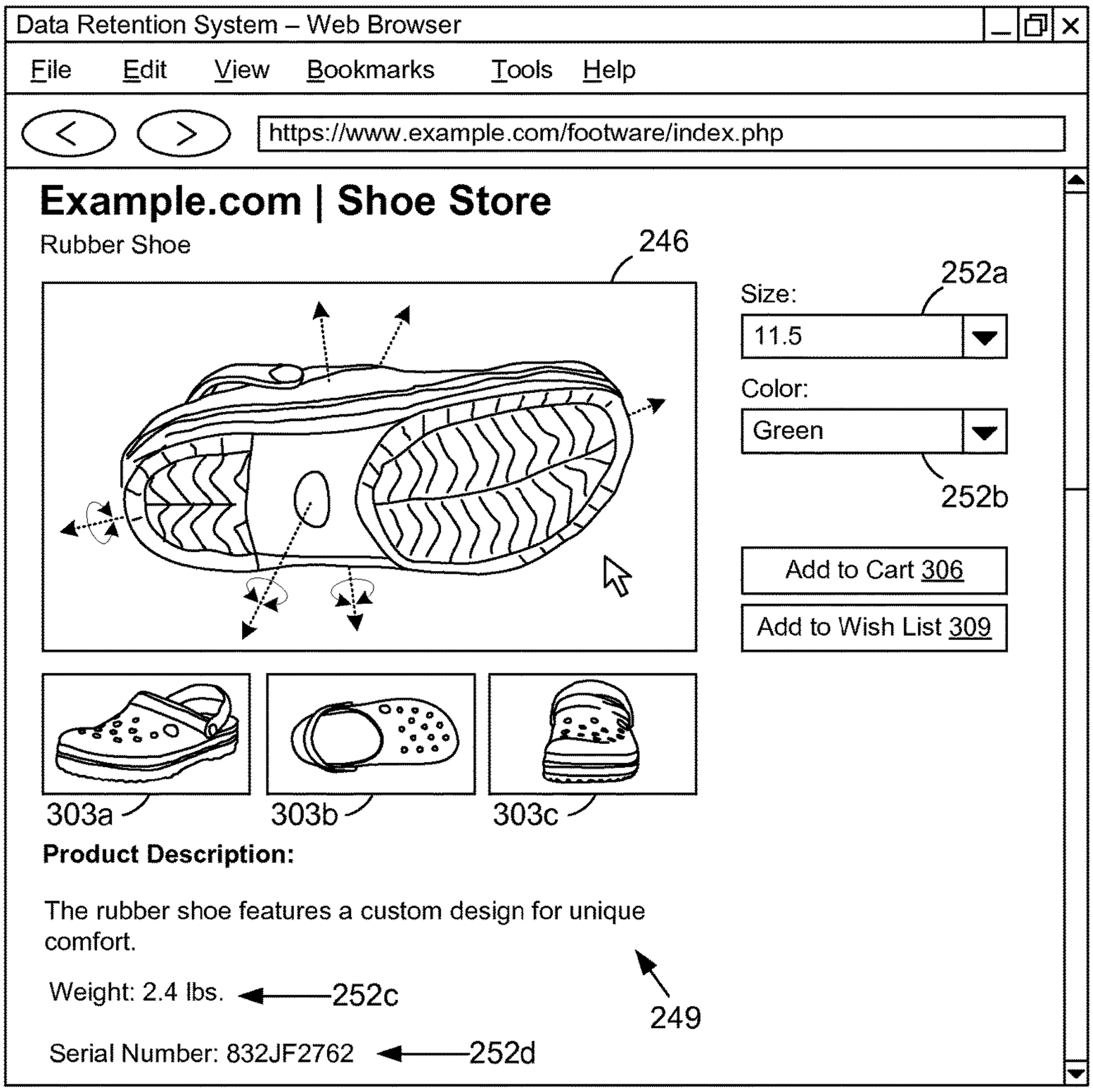
Data Retention System – Web Browser
File Edit View Bookmarks Tools Help
https://www.example.com/footware/index.php
Example.com | Shoe Store
Rubber Shoe
246
Size:
252a
11.5
Color:
Green
252b
Add to Cart 306
Add to Wish List 309
303a
303b
303c
Product Description:
The rubber shoe features a custom design for unique comfort.
Weight: 2.4 lbs.
252c
249
Serial Number: 832JF2762
252d
272

FIG. 3

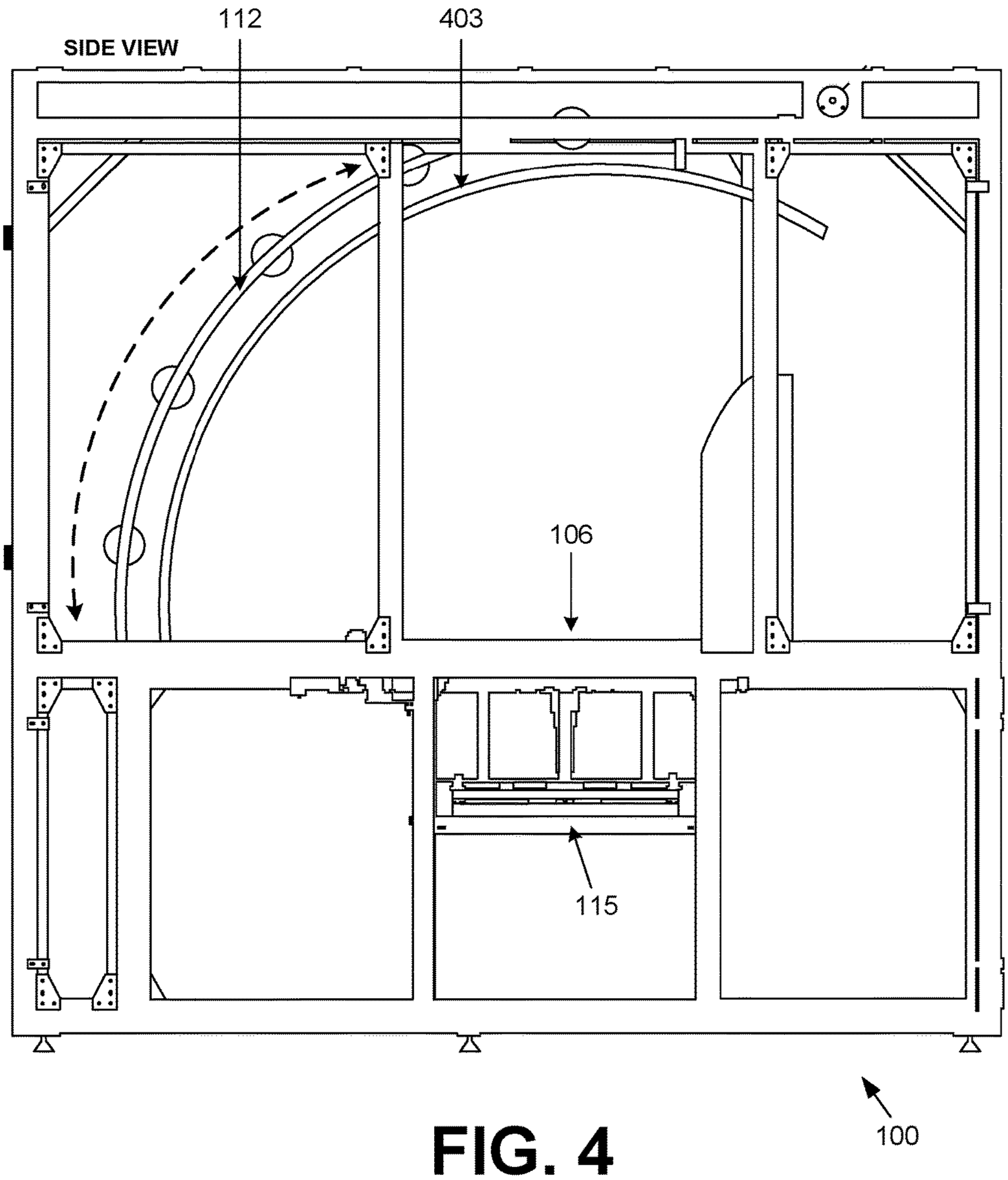


FIG. 4

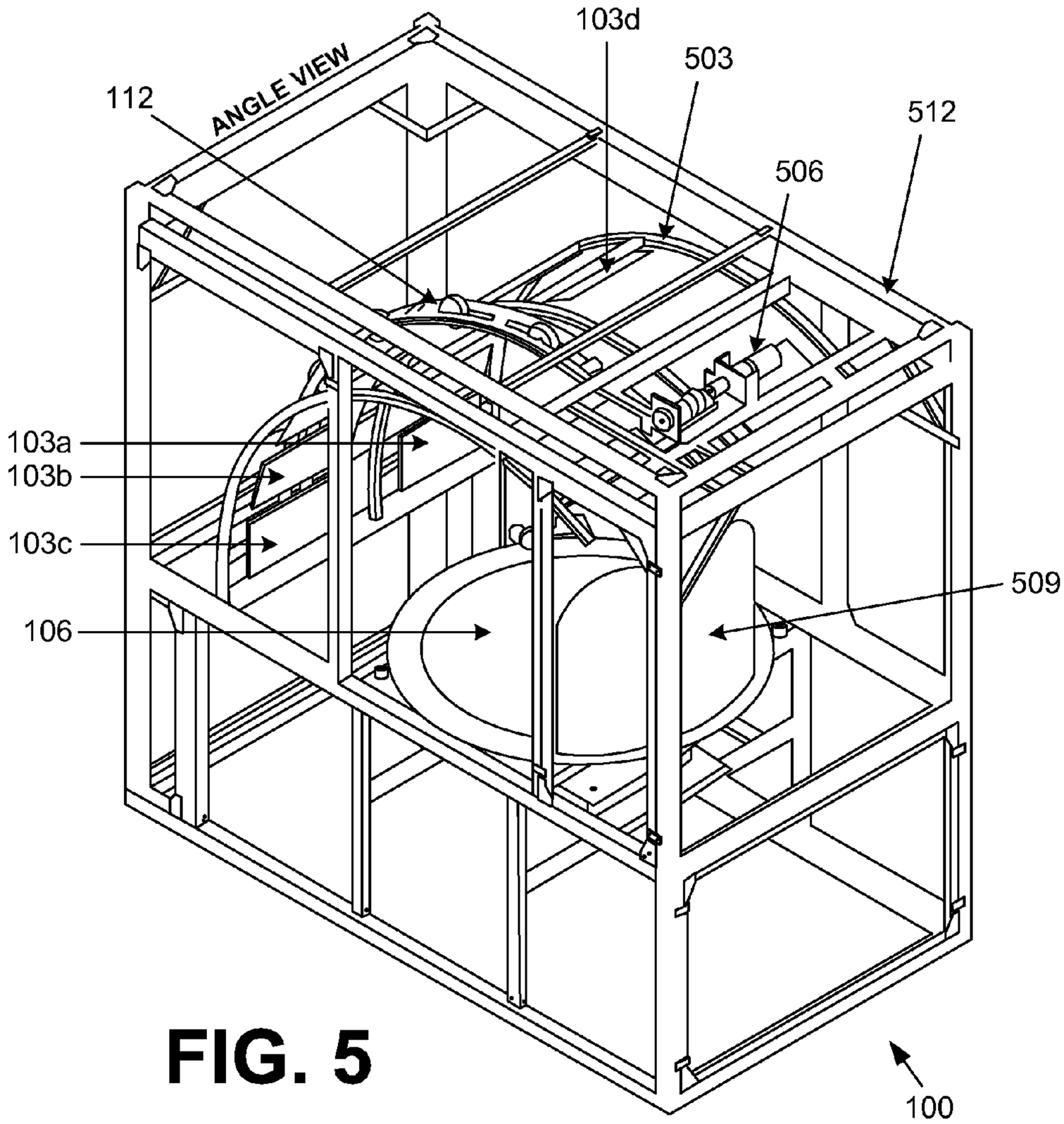


FIG. 5

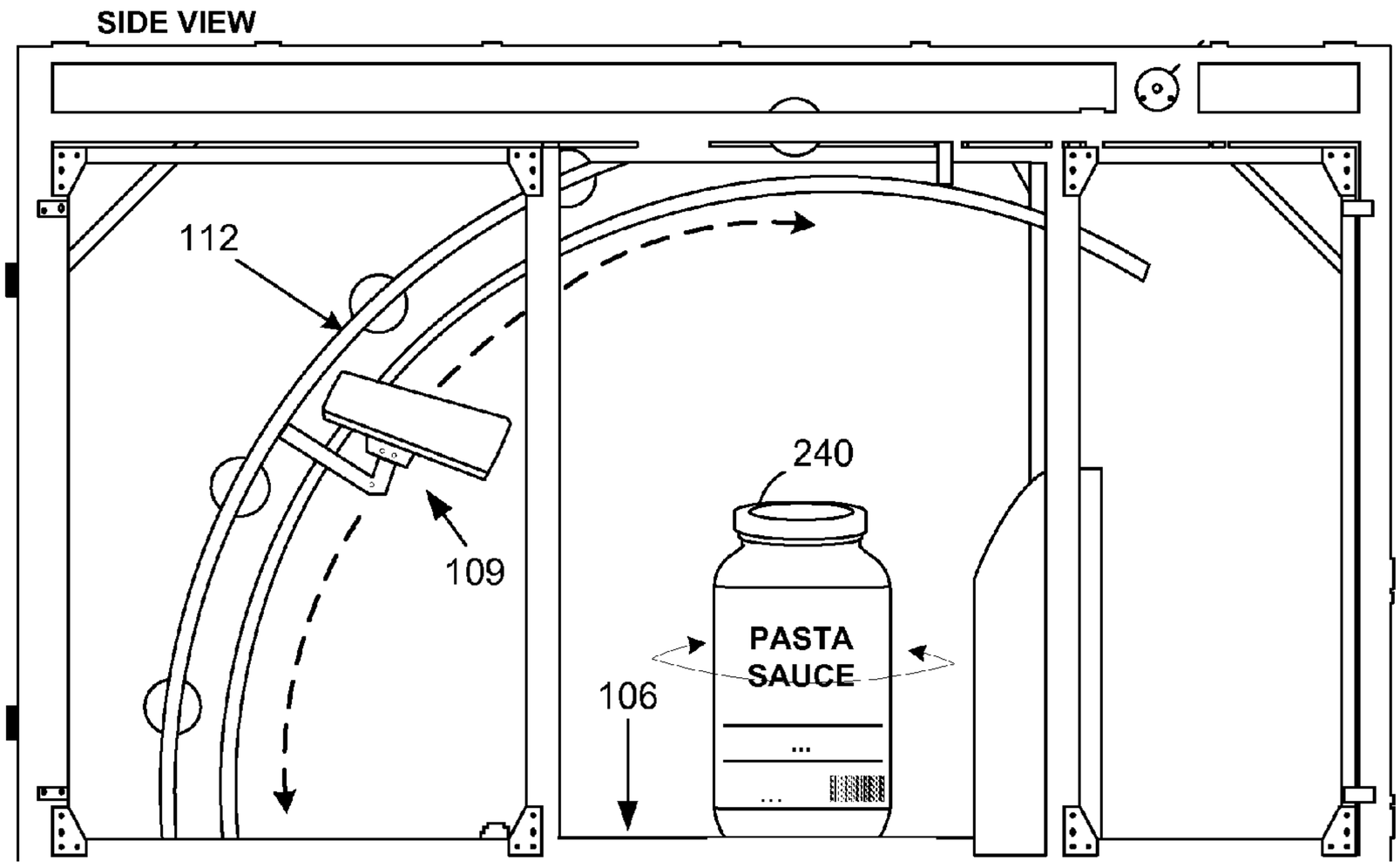
SIDE VIEW
112
109
240
PASTA
SAUCE
106
100

FIG. 6A

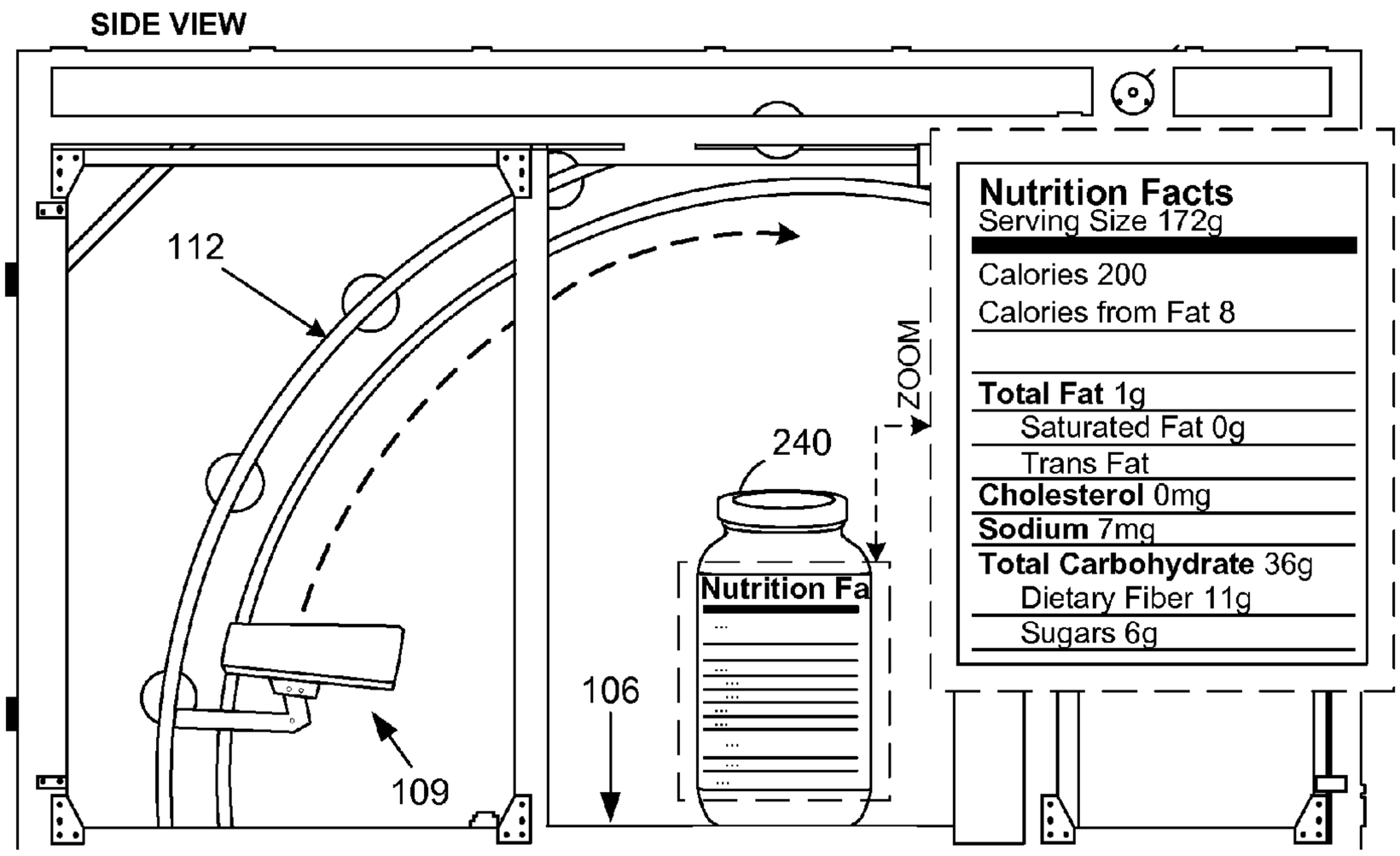
SIDE VIEW
112
109
240
Nutrition Fa
106
ZOOM
Nutrition Facts
Serving Size 172g
Calories 200
Calories from Fat 8
Total Fat 1g
Saturated Fat 0g
Trans Fat
Cholesterol 0mg
Sodium 7mg
Total Carbohydrate 36g
Dietary Fiber 11g
Sugars 6g
100

FIG. 6B

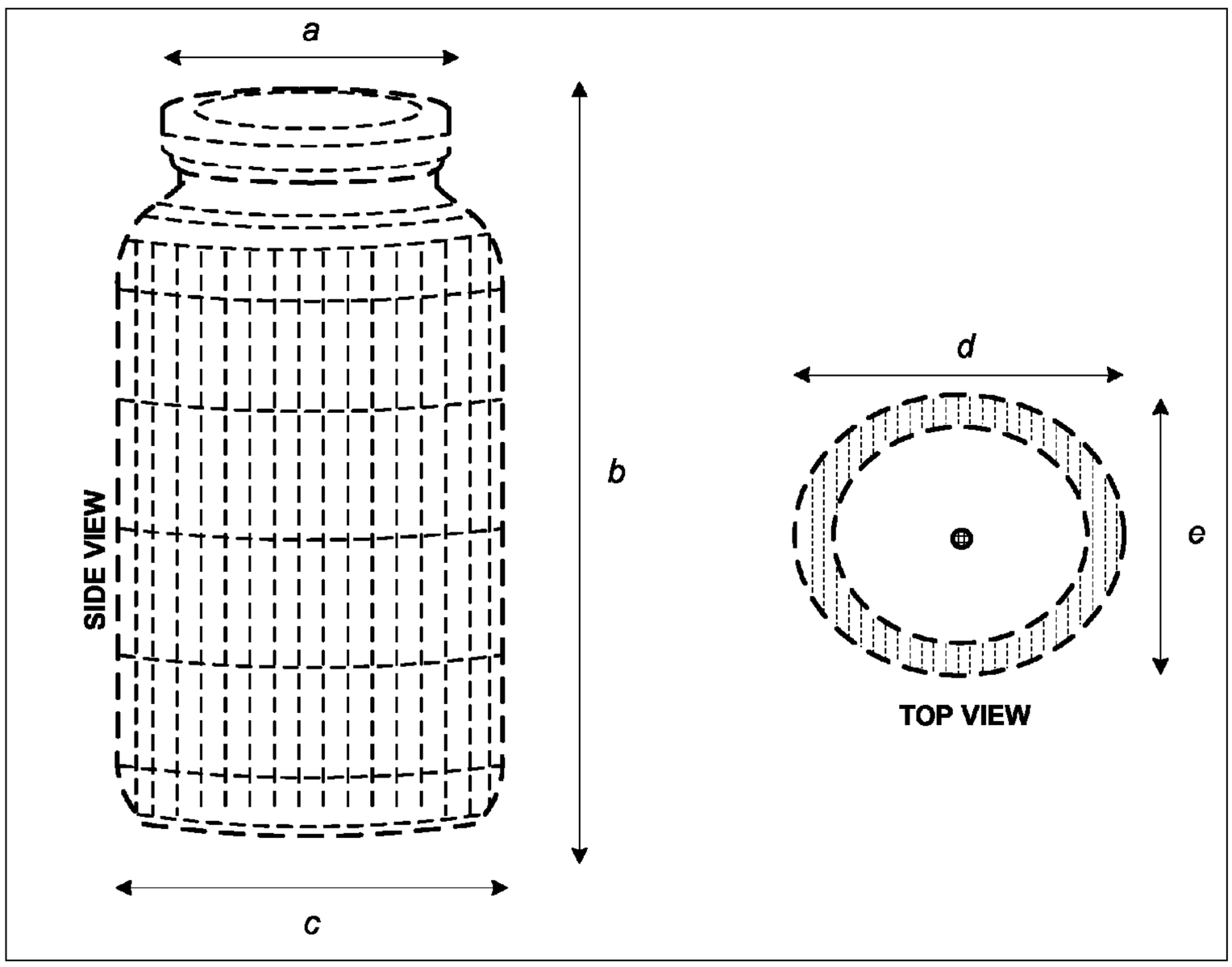


FIG. 7

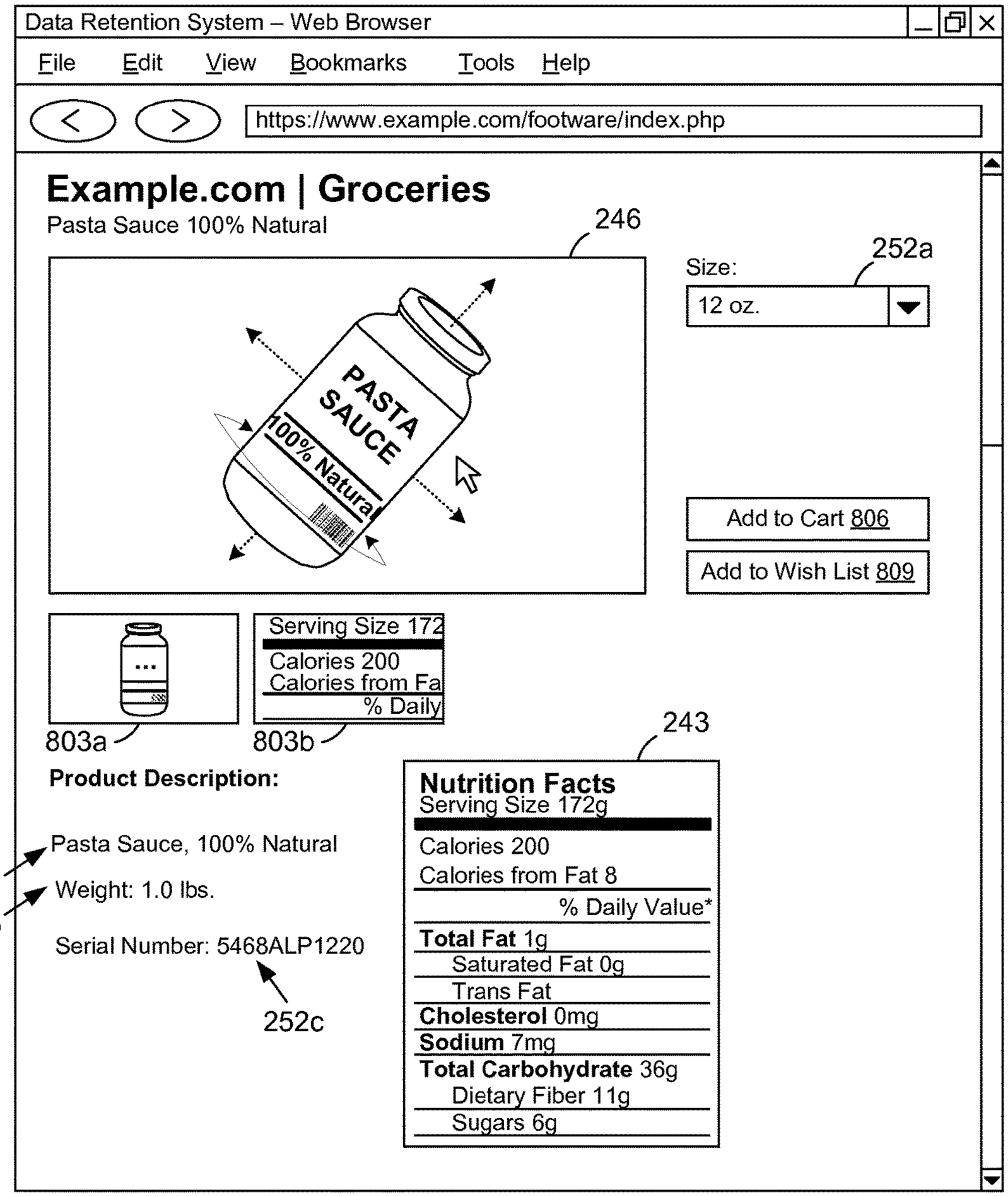
Data Retention System – Web Browser
File Edit View Bookmarks Tools Help
https://www.example.com/footware/index.php
Example.com | Groceries
Pasta Sauce 100% Natural
246
PASTA SAUCE
100% Natural
Size:
252a
12 oz.
Add to Cart 806
Add to Wish List 809
Serving Size 172
Calories 200
Calories from Fa
% Daily
803a
803b
243
Product Description:
Pasta Sauce, 100% Natural
249
Weight: 1.0 lbs.
252b
Serial Number: 5468ALP1220
252c
Nutrition Facts
Serving Size 172g
Calories 200
Calories from Fat 8
% Daily Value*
Total Fat 1g
Saturated Fat 0g
Trans Fat
Cholesterol 0mg
Sodium 7mg
Total Carbohydrate 36g
Dietary Fiber 11g
Sugars 6g
272

FIG. 8

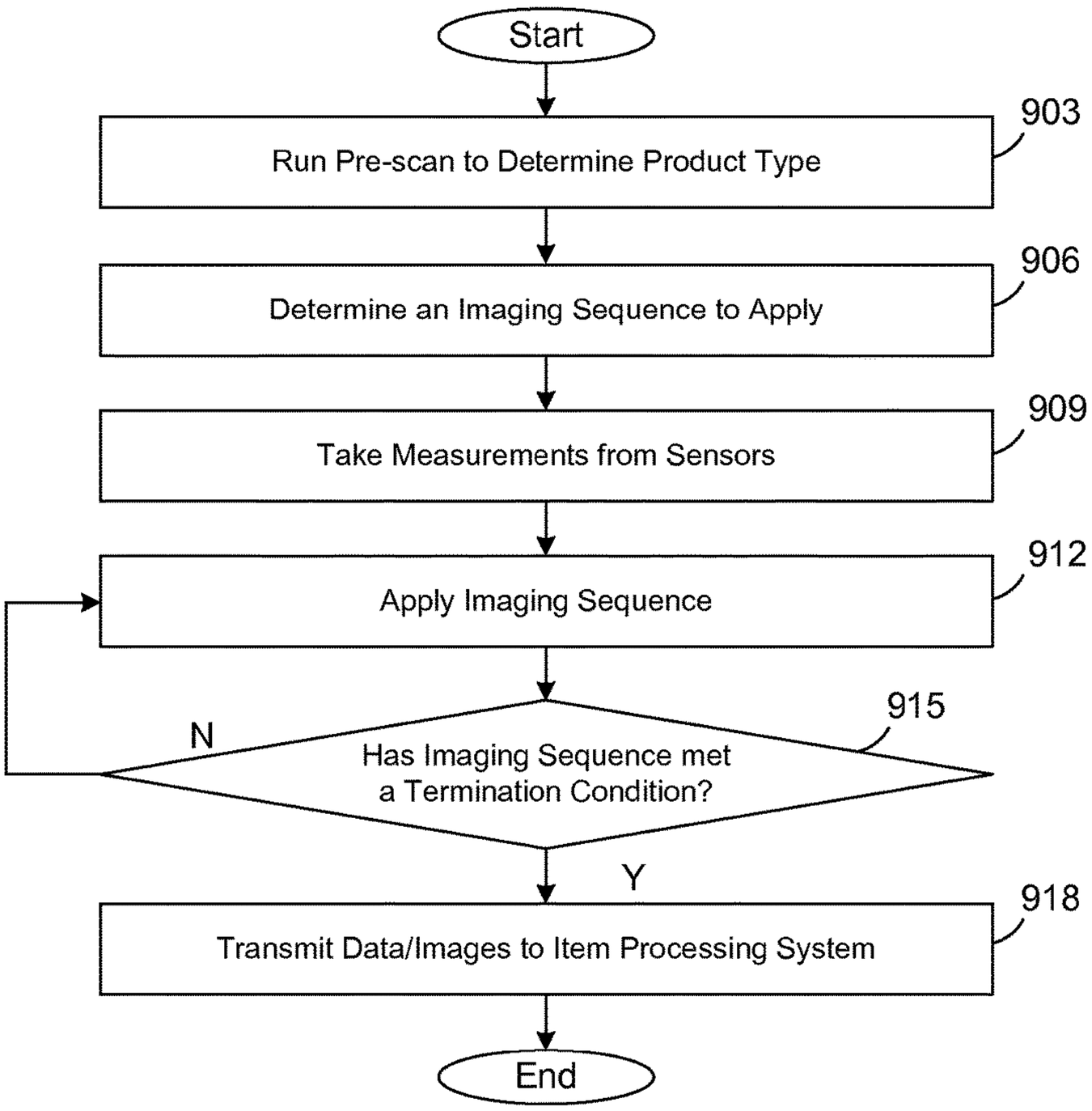
Start
903
Run Pre-scan to Determine Product Type
906
Determine an Imaging Sequence to Apply
909
Take Measurements from Sensors
912
Apply Imaging Sequence
915
N
Has Imaging Sequence met a Termination Condition?
Y
918
Transmit Data/Images to Item Processing System
End
260

FIG. 9

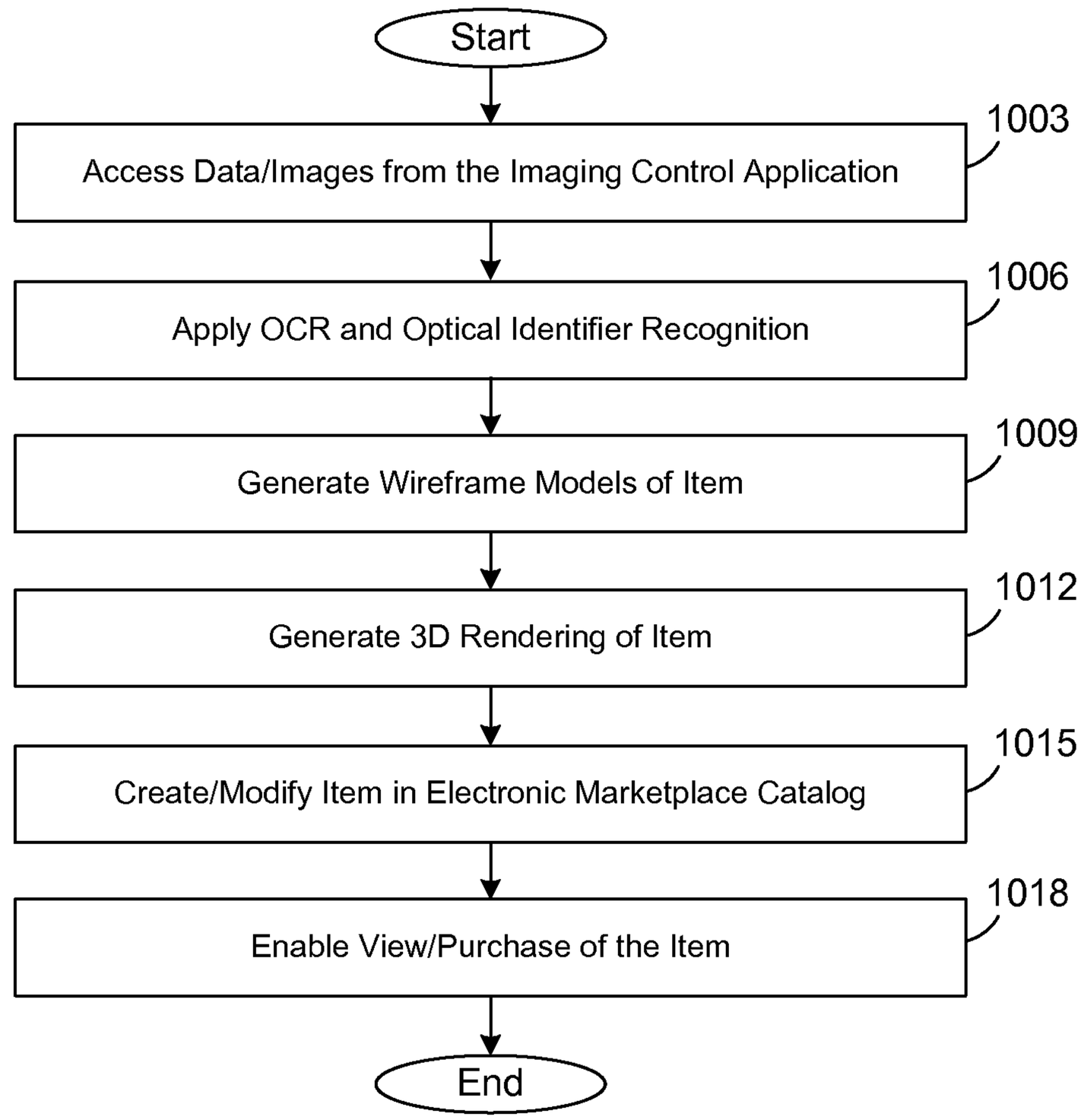
Start
Access Data/Images from the Imaging Control Application
1003
Apply OCR and Optical Identifier Recognition
1006
Generate Wireframe Models of Item
1009
Generate 3D Rendering of Item
1012
Create/Modify Item in Electronic Marketplace Catalog
1015
Enable View/Purchase of the Item
1018
End
223

FIG. 10

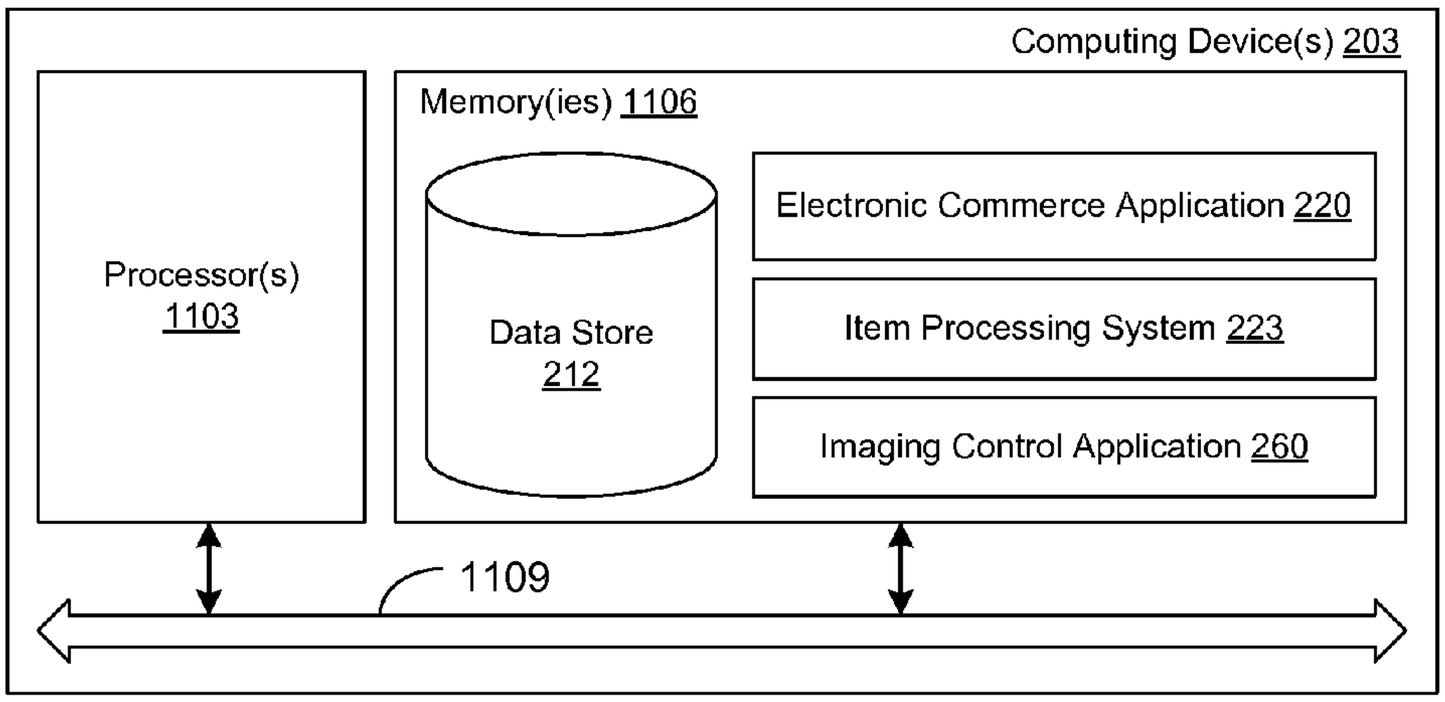
Computing Device(s) 203
Memory(ies) 1106
Processor(s) 1103
Data Store 212
Electronic Commerce Application 220
Item Processing System 223
Imaging Control Application 260
1109

FIG. 11

# AUTOMATED OPTICAL DIMENSIONING AND IMAGING

## BACKGROUND

With the emergence of electronic ecommerce, an abundance of various items are entering the electronic marketplace. Placement of an item in an electronic marketplace traditionally requires manual entry of various information associated with the item.

## BRIEF DESCRIPTION OF THE DRAWINGS

Many aspects of the present disclosure can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale, with emphasis instead being placed upon clearly illustrating the principles of the disclosure. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

FIG. **1** is a drawing of an item imaging apparatus according to various embodiments of the present disclosure.

FIG. **2** is a drawing of a networked environment according to various embodiments of the present disclosure.

FIG. **3** is a drawing of an example of a user interface rendered by a client in the networked environment of FIG. **2** according to various embodiments of the present disclosure.

FIG. **4** is a drawing of the item imaging apparatus of FIG. **1** according to various embodiments of the present disclosure.

FIG. **5** is a drawing of the item imaging apparatus of FIG. **1** according to various embodiments of the present disclosure.

FIGS. **6**A-B are drawings of the item imaging apparatus of FIG. **1** imaging an item according to various embodiments of the present disclosure.

FIG. **7** is a drawing of a generated three-dimensional wireframe corresponding to the imaged item of FIGS. **6**A-B.

FIG. **8** is a drawing of an example of a user interface rendered by a client in the networked environment of FIG. **2** according to various embodiments of the present disclosure.

FIG. **9** is a flowchart illustrating one example of functionality implemented as portions of the imaging control application executed in a computing environment in the networked environment of FIG. **2** according to various embodiments of the present disclosure.

FIG. **10** is a flowchart illustrating one example of functionality implemented as portions of the item processing system executed in a computing environment in the networked environment of FIG. **2** according to various embodiments of the present disclosure.

FIG. **11** is a schematic block diagram that provides one example illustration of a computing environment employed in the networked environment of FIG. **2** according to various embodiments of the present disclosure.

## DETAILED DESCRIPTION

The present disclosure relates to imaging items in order to automatically generate media and/or data associated with an item. When items are received by a merchant, human intervention generally must take place requiring a person to fill out a profile of the item to be sold by the merchant. A detailed profile of an item requires manual entry of various details associated with the item that may be used in the sale



of the item. Such information may be the item name, weight, dimensions, description, and/or other information associated with the item. Additionally, images and/or three-dimensional renderings of the item must be created. Three-dimensional renderings, for example, permit customers of electronic marketplaces the ability to inspect an item from multiple angles. Accordingly, it may be desirable to employ an automated process whereby various images, three-dimensional renderings, and item data are generated automatically. In the following discussion, a general description of the system and its components is provided, followed by a discussion of the operation of the same.

With reference to FIG. **1**, shown is an example of an item imaging apparatus **100** according to various embodiments capable of capturing data and/or media associated with an item from various angles. In this non-limiting example, multiple lights **103***a*, **103***b*, and **103***c*, may be fixed to a curved light mount in order to provide varying angles of light to an item that may be supported by a platform **106** that is capable of rotation. An imaging device **109** (not shown), e.g., a camera, may be mounted and/or supported by a fixture set in a similarly curved track **112** or pathway in order to permit the movement of the device from one position to another in order to capture varying angles of media of the item positioned on the platform **106**.

Next, a discussion of the computing environment is provided in which a user interface is generated followed by a discussion of the operation of the same.

With reference to FIG. **2**, shown is a networked environment **200** according to various embodiments. The networked environment **200** includes a computing device **203**, a client device **206**, and an item imaging apparatus **100**, which are in data communication with each other via a network **209**. The network **209** includes, for example, the Internet, intranets, extranets, wide area networks (WANs), local area networks (LANs), wired networks, wireless networks, or other suitable networks, etc., or any combination of two or more such networks.

The computing device **203** may comprise, for example, a server computer or any other system providing computing capability. Alternatively, the computing device **203** may employ a plurality of computing devices that may be employed that are arranged, for example, in one or more server banks or computer banks or other arrangements. Such computing devices may be located in a single installation or may be distributed among many different geographical locations. For example, the computing device **203** may include a plurality of computing devices that together may comprise a cloud computing resource, a grid computing resource, and/or any other distributed computing arrangement. In some cases, the computing device **203** may correspond to an elastic computing resource where the allotted capacity of processing, network, storage, or other computing-related resources may vary over time.

Various applications and/or other functionality may be executed in the computing device **203** according to various embodiments. Also, various data is stored in a data store **212** that is accessible to the computing device **203**. The data store **212** may be representative of a plurality of data stores **212** as can be appreciated. The data stored in the data store **212**, for example, is associated with the operation of the various applications and/or functional entities described below.

The components executed on the computing device **203**, for example, include an electronic commerce application **220**, an item processing system **223**, and other applications, services, processes, systems, engines, or functionality not discussed in detail herein.

The electronic commerce application **220** is executed in order to facilitate the online purchase of items **240** in an electronic marketplace **230** over the network **209**. The electronic commerce application **220** also performs various backend functions associated with the online presence of a merchant in order to facilitate the online purchase of items **240** as will be described. For example, the electronic commerce application **220** generates network pages such as web pages or other types of network content that are provided to clients **206** for the purposes of selecting items for purchase, rental, download, lease, or other form of consumption as will be described.

The item processing system **223** is executed to receive and/or access data and/or images **243** from the item imaging apparatus **100** and/or from the imaging control application **260**. The item processing system **223** may perform various analyses on the data and/or images **243** in order to generate additional data associated with an item **240**. The item processing system **223** may then store the data, images, three-dimensional renderings **246**, three-dimensional wireframes, and/or any other information in association with the item **240** in a data store **212**. Additionally, the item processing system **223** may determine and/or apply imaging sequences **118** to an imaging of an item **240** by the item imaging apparatus **100**. An imaging sequence **118** comprises an orchestrated set of actions conducted in the item imaging apparatus **100** in order to successfully capture media and/or data corresponding to an item **240**. The actions may include, for example, controlling the luminous intensity of the lights **103**; the rotation of the platform **106**; a reading of the sensors **115**; the movement of an actuator, the capture process of an imaging device **109**, and/or potentially other actions, all at various stages of an imaging process. The imaging sequence **118** may further control various features associated with one or more imaging devices **109** such as an adjustment of a tilt angle of an imaging device, a shutter speed, a zoom level, a lens aperture, one or more International Standards Organization (ISO) settings that adjust a sensitivity to light, and/or any other feature associated with the one or more imaging devices **109**.

An imaging sequence **118** applied by the item imaging apparatus **100** in creating the data and/or media associated with the item **240** may be compared to the resulting data and/or media. For example, if it was determined that the imaging sequence **118** produced high-quality images of the item **240**, which, in turn, generated high-quality three-dimensional renderings **246** of the item, the imaging sequence **118** may be scored and/or stored in data store **212** to be used in the future. Similarly, if the imaging sequence **118** applied by the item imaging apparatus **100** produced low-quality images of the item **240**, the item processing system **223** may determine a new sequence **233** to apply. Ultimately, the item processing system **223** may modify permissions associated with the item **240** in order to make the item **240** available to view and/or purchase in an electronic marketplace **230** via the electronic commerce application **220**.

The data stored in the data store **212** includes, for example, data associated with an electronic marketplace **230**, sequences **233**, and potentially other data. Data associated with the electronic marketplace **230** may include information related to a plurality of items **240** offered in the electronic marketplace. An item **240** may refer to a product, good, or any combination, bundle, or package thereof, that may be offered for sale, purchase, rental, lease, download, and/or any other form of consumption as can be appreciated. Item images **243**, generated three-dimensional renderings **246**, and/or an item description **249** may be stored in association with an item **240**. Similarly, various item attributes **252** may be stored in association with an item **240**. Such attributes may include, for example, titles, descriptions, quantities, conditions, images, options, weights, customer reviews, customer ratings, keywords, shipping restrictions, prices, tax classifications, unique identifiers, and/or any other data related to the items.

Imaging sequences **233** may be stored in data store **212** in order for the item processing system **223** to convey imaging sequences **233** to the imaging control application **260** executed on a client **206**. Imaging sequences **233** may contain instructions on how to image and/or collect data associated with an item **240** via item imaging apparatus **100**. Additionally, imaging sequences **233** may be stored in association with a category of an item **240**.

The client **206** is representative of a plurality of client devices that may be coupled to the network **209**. The client **206** may comprise, for example, a processor-based system such as a computer system. Such a computer system may be embodied in the form of a desktop computer, a laptop computer, personal digital assistants, cellular telephones, smartphones, set-top boxes, music players, web pads, tablet computer systems, game consoles, electronic book readers, or other devices with like capability. The client **206** may include a display **266**. The display **266** may comprise, for example, one or more devices such as liquid crystal display (LCD) displays, gas plasma-based flat panel displays, organic light emitting diode (OLED) displays, LCD projectors, or other types of display devices, etc.

The client **206** may be configured to execute various applications such as a client application and/or other applications. The client application may be executed in a client **206**, for example, to access network content served up by the computing device(s) **203** and/or other servers, thereby rendering a user interface **272** on the display **266**. The client application may, for example, correspond to a browser, a mobile application, etc., and the user interface **272** may correspond to a network page, a mobile application screen, etc. The client **206** may be configured to execute applications beyond the client application such as, for example, an imaging control application **260**, browsers, mobile applications, email applications, social networking applications, and/or other applications.

The imaging control application **260** is executed to receive an imaging sequence **118** from the item processing system **223** or determine an imaging sequence **118** independent of the item processing system **223**. By applying an imaging sequence **118** to the item imaging apparatus **100**, the imaging control application **260** may control the components of the item imaging apparatus **100** during an imaging process. For example, an imaging sequence **118** may be applied based at least in part on the nature of the item **240** being imaged. The imaging sequence **118** initiated by the imaging control application **260** may control the various components of the item imaging apparatus **100**.

Next, a general description of the operation of the various components of the networked environment **200** is provided. To begin, it is understood that an impending imaging process exists in order to generate data and/or media describing an item **240**. An imaging control application **260** executed on a client device **206** may determine an imaging sequence **118** to apply to an item **240**. A certain imaging sequence **118** may be specific to a certain type of item **240** and/or a may be specific to a category associated with the item **240**. For example, a particular imaging sequence **118** may be used if the item **240** is a box (e.g. a cereal box) as opposed to a

different imaging sequence **118** that may be used if it were determined in box **903** that the item **240** is a jar (e.g. pasta sauce). Alternatively, the imaging control application **260** may request a sequence from the item processing system **223** which may in turn access a sequence **233** previously stored in data store **212**. The imaging sequence **118** determined may be based at least in part on the type of item **240** being imaged. For example, a pre-scan may occur by the item imaging apparatus **100** in order to determine the type of item **240** being imaged. The pre-scan may include taking a still image of the item **240** in order to determine the type of the item **240** by performing various analyses on the image. For example, the item imaging apparatus **100** may direct the imaging device **109** to take an image of an optical identifier, e.g., a barcode. The imaging control application **260** or the item processing system **223** may apply an optical character recognition to the optical identifier in order to determine a category associated with the item **240** and/or a type of item **240**. Alternatively, optical recognition of an image of an item label may identify a description of the item **240** which may be used in determining the type of the item **240**.

Upon determination of an imaging sequence **118**, the imaging sequence **118** may subsequently control an imaging process of the item **240**. For example, the imaging sequence **118** may control the components of the item imaging apparatus **100** in order to perform the imaging process. Alternatively, the imaging control application **260** may control the components of the item imaging apparatus **100**. Control of the components may include controlling the luminous intensity of the lights **103**; the rotation of the platform **106**; a reading of the sensors **115** at various points of the capture process; and/or the movement, zoom levels, tilt, and/or the capture process of an imaging device **109**.

The imaging process generates data and/or media corresponding to the item **240**. The media may comprise, for example, images, audio, and/or video of the item **240**. The data may comprise information obtained from the sensors **115** and/or data obtained from the media. Upon completion or during the imaging process, the data and/or media obtained via the item imaging apparatus **100** may be transmitted and/or communicated to the imaging control application **260** to be sent to the item processing system **223** over a network **209**. In alternative embodiments, the item imaging apparatus **100** may include an imaging control application **260** independent of a client device **206** and/or may communicate directly with the item processing system **223** via the network **209**.

Upon receipt and/or access of the data and/or media obtained during the imaging process, the item processing system **223** may perform various analyses on the data and/or media to determine information about the item **240**. For example, optical recognition results may be used in determining a name, description, dimensions, weight, item type, category type, and/or any other information associated with the item **240**. Similarly, optical recognition results may determine symbols located on the item **240**. The symbols may be used in categorizing the item **240**. For example, certain symbols may suggest that a food item is organic. The description **249** of the food item may be generated to include that the item **240** is organic. Other symbols may suggest, for example, sweeteners, regions of origin, hazardous material, hardware requirements, temperature rating, etc.

The item processing system **223** may apply post-processing on the media generated during an imaging sequence **118**. For example, undesirable shadows, irregularities, and/or artifacts may be detected and/or removed from the media. The item processing system **223** may further determine static images that may be ideal in placing the item on a product page in an electronic commerce application **220**. For example, a frontal image of the product may be taken as a "main" image of the product to be used in a product page.

The item processing system **223** may generate three-dimensional models and/or three-dimensional renderings **246** of the item **240**. A three-dimensional model, discussed below with respect to FIG. **7**, may be used in determining the dimensions of the item **240** associated with the length, width, and/or height of the item **240**. Static images **243** taken during the imaging process and/or derived from the media may be selected based on a degree of usability of the image.

The resulting data generated by the item processing system **223** may be used in determining a quality of the imaging sequence **118** applied during the imaging process. For example, the item processing system **223** may analyze the images **243**, the three-dimensional renderings **246**, the item description **249**, and/or the item attributes **252** to identify any existing irregularities and/or a degree of usability. A score indicating the degree of the usability may be assigned to the imaging sequence **118** and the imaging sequence **118** may be saved in data store **212** as a sequence **233** to be used in future imaging processes. For example, the next similar item **240** imaged by the item imaging apparatus **100** may select an imaging sequence **118** associated with a high quality based at least in part on the score.

Upon generation of the information associated with the item **240**, the item processing system **223** may store the information in the data store **212** relative to an electronic marketplace **230**. An electronic commerce application **220** may access the information associated with an item **240** to generate a user interface **272** in order to permit a user of the electronic commerce application **220** the ability to view and/or purchase the item **240** over the network **209**.

Referring next to FIG. **3**, shown is an example of a user interface **272** in the browser **269** (FIG. **2**) executed in the client **206** (FIG. **2**) in the networked environment **200** (FIG. **2**) according to various embodiments. Alternatively, the user interface **272** may be rendered on a client **206** by a dedicated application. Specifically, the user interface **272** depicts a network page generated by, for example, an electronic commerce application **220** (FIG. **2**). In this non-limiting example, an item **240** (FIG. **2**), i.e., a rubber shoe, is depicted as an item **240** available to view and/or purchase in an electronic marketplace **230** (FIG. **2**).

As may be appreciated, the item **240** is visually represented by a three-dimensional rendering **246** of the item **240**. Upon engagement of a dynamic three-dimensional rendering **246** of the item **240** by a user, the angle of the three-dimensional rendering **246** depicted in the network page may be dynamically altered by the user. For example, a user may control the angle of the three-dimensional rendering **246** in order to inspect all angles of the rubber shoe in a xyz plane by clicking and/or dragging on the image using a mouse cursor. Similarly, the user may be able to zoom in and/or out in order to inspect minor details of the item **240** or to view the entire item **240**. Thumbnails **303***a*, **303***b*, and **303***c*, may be engaged by the user in order to change the angle presented by the three-dimensional rendering **246** to a predefined angle and/or to swap the three-dimensional rendering **246** with a static image.

Attributes **252***a*, **252***b*, **252***c*, and/or **252***d* associated with the item **240** may be shown in the user interface **272**. Accordingly, attribute data **252** may be used in presenting options available for purchase in the electronic marketplace **230**. For example, the size and/or color of a shoe may be offered to a user as attributes **252***a* and **252***b*. Similarly, the

weight, dimensions, and/or item serial number may be shown to a user to present relevant information potentially helpful to a user during the purchase of an item **240**. Additionally, a description **249** associated with the item **240** may be helpful to a user during the purchase of an item **240**. An "Add to Cart" button **306** and an "Add to Wish List" button **309** may initiate the purchase or future purchase of an item **240** depicted in the user interface **272** of an electronic marketplace **230**, as may be appreciated.

The attributes **252** and/or the description **249** shown in the user interface **272** may be dynamically generated as discussed in greater detail below. In the following discussion, a general description of compiling and/or generating the information and images via the system and its components is provided, followed by a discussion of the operation of the same.

Turning now to FIG. **4**, shown is a side view of an example item imaging apparatus **100** according to various embodiments. In this non-limiting example, a curved light mount **403** may be used to support lights and/or light panels in order to provide varying angles of light. An imaging device **109** (not shown), e.g., a camera, may be mounted and/or supported by a fixture fixated in a similarly curved track **112** or curved pathway in order to permit the movement of the device from one position to another in order to capture varying angles of images and/or video of the item **240** (FIG. **2**) supported by the platform **106**. An actuator or motor assembly (not shown), discussed below, may initiate and/or conduct the movement of the imaging device along the track or pathway.

Various sensors **115** may be used throughout the item imaging apparatus **100**. For example, a sensor assembly **115** comprising a scale positioned below the platform **106** may measure, monitor and/or record the weight of the item supported by the platform **106**. Similarly, the item imaging apparatus **100** may comprises sensors and/or sensor assemblies capable of measuring the luminous intensity of the lights at various locations, the position of the imaging devices on the curved track **112** or curved pathway, the tilt angle of the imaging device, the angle of rotation of the platform **106**, and/or other sensors as may be appreciated.

Moving on to FIG. **5**, shown is an angular view of an example item imaging apparatus **100** according to various embodiments. In this non-limiting example, multiple lights **103***a*, **103***b*, and **103***c*, may be supported by a curved light mount **503** in order to provide varying angles of light to an item that may be supported by the platform **106**. An imaging device **109** (not shown), e.g., a camera, may be mounted and/or supported by a fixture set in a similarly curved track **112** or curved pathway in order to permit the movement of the device from one position to another in order to capture varying angles of images of the item positioned on the platform **106**. Alternatively, the imaging device **109** may be directly set on the curved track **112** or curved pathway. An actuator or motor assembly **506** may initiate and/or conduct the movement of the imaging device **109** along the curved track **112** or curved pathway from one position to another.

A reflector **509** may be connected to the platform **106** in order to provide a consistent lighting of the item **240** (FIG. **2**) by the lights **103** as well as minimize any shadows. A frame **512** may support the components of the item imaging apparatus **100**. For example, the platform **106**, one or more curved mounts **503**, and/or one or more curved tracks **112** or curved pathways, may be coupled to the frame **512** for support. The frame **512** may additionally encapsulate any wires used by the various components of the item imaging apparatus **100** such as those that may be necessary to power the device and/or communicate with one or more client devices **206**. One or more backdrops, screens, and/or canvases (not shown) may be fixed on the interior and/or exterior of the frame **512**. The color of the backdrop may reflect the color of a background of the media taken of the item. For example, a white backdrop encapsulating the frame **512** may produce an image of an item with a white background. Similarly, a green backdrop may encapsulate the frame **512** to produce an image of an item with a "green screen" background which may be ideal in applying a digital background to an image of an item.

Referring next to FIGS. **6**A-B, shown are examples of an item **240** situated in the item imaging apparatus **100**. As shown, the item **240**, not drawn to scale, may rotate while situated on the platform **106** permitting the imaging device **109** to capture media of all sides and angles of the item **240**. The imaging device **109** may move from the bottom of the track **112**, located at the bottom of item imaging apparatus **100**, to the top of the track **112**. At the top of the track **112**, the imaging device **109** may capture an aerial view of the item **240**. While at a lower position on the track **112**, the imaging device **109** may capture still images of labels, icons, symbols, characters, and/or other characteristics that may appear on the item **240**, its packaging, and/or its labels. In the non-limiting example of FIG. **6**B, the imaging device **109** is located near the bottom of the track **112** in order to capture an image of a label of the item **240**. The label contains, for example, nutritional facts which may be later used in generating data associated with the item **240**.

Turning now to FIG. **7**, shown is an example of a three-dimensional wireframe that may be generated by the item processing system **223** (FIG. **2**). One or more three-dimensional wireframes may be used in the determination of various dimensions of an item **240**. Dimensions may include, for example, the length, width, and/or height of the item **240** imaged by the item imaging apparatus **100** (FIG. **1**). As may be appreciated, dimensions may be stored in association with an item **240** as an attribute **252** (FIG. **2**). Similarly, the three-dimensional wireframes may be used in the generation of three-dimensional renderings **246** (FIG. **2**) associated with the item that may be shown in a user interface **272** (FIG. **2**). In the non-limiting example of FIG. **7**, two wireframes associated with the item **240** of FIGS. **6**A-B, may be generated by the item processing system **223**.

Moving on to FIG. **8**, shown is shown is an example of a user interface **272** in the browser **269** (FIG. **2**) executed in the client **206** (FIG. **2**) in the networked environment **200** (FIG. **2**) according to various embodiments. Alternatively, the user interface **272** may be rendered on a client **206** by a dedicated application. Specifically, the user interface **272** depicts a network page generated by, for example, an electronic commerce application **220** (FIG. **2**). In this non-limiting example, an item **240**, i.e., a jar of pasta sauce previously shown in FIGS. **6**A-B and FIG. **7**, is depicted as an item **240** available to view and/or purchase in an electronic marketplace **230** (FIG. **2**).

The item **240** is visually represented by a three-dimensional rendering **246** of the item **240** generated by the item processing system **223** (FIG. **2**). Upon engagement of a dynamic three-dimensional rendering **246** of the item **240** by a user, the angle of the three-dimensional rendering **246** depicted in the network page may be dynamically altered by the user. For example, a user may control the angle of the three-dimensional rendering **246** in order to inspect all angles of the jar in a xyz plane by clicking and/or dragging on the image using a mouse cursor. Similarly, the user may be able to zoom in and/or out in order to inspect minor

details of the item **240** or to view the entire item **240**. Thumbnails **803***a* and **803***b* may be engaged by the user in order to change the angle presented by the three-dimensional rendering **246** to a predefined angle and/or to swap the three-dimensional rendering **246** with a static image.

Attributes **252***a*, **252***b*, and/or **252***c* associated with the item **240** may be shown in the user interface **272**. Accordingly, attribute data **252** may be used in presenting options available for purchase in the electronic marketplace **230**. For example, the size of the jar of pasta sauce may be offered to a user as attribute **252***a*. Similarly, the weight, dimensions, and/or item serial number may be shown to a user to present relevant information potentially helpful to a user during the purchase of an item **240**. Additionally, a description **249** associated with the item **240** may be helpful to a user during the purchase of an item **240**. An "Add to Cart" button **806** and an "Add to Wish List" button **809** may initiate the purchase or future purchase of an item **240** depicted in the user interface **272** of an electronic marketplace **230**, as may be appreciated. Additionally, images **243** of the item **240**, the label of the item **240**, and/or any other images of the item **240** may be shown in the user interface **272**. In this non-limiting example, an image **243** from the label of the jar displaying the nutritional facts associated with the item **240** is shown in the user interface **272**.

It is understood that optical character recognition may be applied to the label in order to extract the nutritional information from the jar, as may be appreciated. Additionally, it is understood that the attributes **252** and/or the description **249** shown in the user interface **272** may be dynamically generated from the data obtained from the item imaging apparatus **100** and/or the item processing system **223**.

Referring next to FIG. **9**, shown is a flowchart that provides one example of the operation of a portion of the imaging control application **260** according to various embodiments. It is understood that the flowchart of FIG. **9** provides merely an example of the many different types of functional arrangements that may be employed to implement the operation of the portion of the imaging control application **260** as described herein. As an alternative, the flowchart of FIG. **9** may be viewed as depicting an example of steps of a method implemented in the client device **206** (FIG. **2**) according to one or more embodiments.

Beginning with box **903**, an optional pre-scan of the item **240** (FIG. **2**) may be conducted in order to determine a product type and/or a category associated with the item **240**. The pre-scan may include taking a picture of the item **240** in order to determine the type of the item **240** by performing various analyses on the image. For example, the item imaging apparatus **100** (FIG. **2**) may direct an imaging device **109** (FIG. **2**) to take an image of an optical identifier, e.g., a barcode. By applying an optical character recognition, a category of the item **240** may be identified from the barcode.

Subsequently, in box **906**, the type of the item **240** and/or a category associated with the item **240** identified in box **903** may be used in determining an imaging sequence **118** (FIG. **2**) to apply. Accordingly, a certain imaging sequence **118** may be specific to a certain type of item **240** and/or specific to a category associated with the item **240**. For example, a particular imaging sequence **118** may be used if the item **240** is a box (e.g. a cereal box) as opposed to a different imaging sequence **118** that may be used if it were determined in box **903** that the item **240** is a jar (e.g. pasta sauce). It is understood that if a type of the item **240** and/or a category associated with the item **240** were unable to be determined in box **903**, a default imaging sequence **118** may be applied. Additionally, a type of the item and/or a category associated with the item **240** may be defined by a user.

In box **909**, various sensors in the item imaging apparatus **100** may be read and/or measured during and/or after an imaging sequence **118**. For example, the weight of the item **240** subject to the imaging sequence **118** may be measured. Additionally, sensors associated with the position of the image device **109** (FIG. **2**), the luminous intensity of the lights **103** (FIG. **1**), and/or any other sensors **115** (FIG. **2**) used in the item imaging apparatus **100**, may be measured. In box **912**, the imaging sequence **118** is applied to control an imaging process of the item **240**. For example, the imaging sequence **118** may control the components of the item imaging apparatus **100** in order to perform the imaging process. Control of the components may include controlling the luminous intensity of the lights **103**; the rotation of the platform **106** (FIG. **1**); a reading of the sensors **115** at various points of the capture process; the movement, zoom, tilt, and/or the capture process of an imaging device **109**; and/or other potential components.

In box **915**, is it determined whether a termination condition exists so that the imaging sequence **118** may be completed. For example, a termination condition may exist requiring all angles of an item **240** be captured by the imaging device. Alternatively, a termination condition may exist at a predefined period of time. In another embodiment, a termination condition may exist if a component of the item imaging apparatus **100** were to fail or become unresponsive. If a termination condition has failed to be met, the imaging sequence **118** in box **912** may continue uninterrupted and/or may restart. Alternatively, if a termination condition has been met, in box **918**, the images and/or data obtained from the imaging sequence **118** may be stored in a data store **212** and/or transmitted to an item processing system **223** (FIG. **2**).

Turning now to FIG. **10**, shown is a flowchart that provides one example of the operation of a portion of the item processing system **223** according to various embodiments. It is understood that the flowchart of FIG. **10** provides merely an example of the many different types of functional arrangements that may be employed to implement the operation of the portion of the item processing system **223** as described herein. As an alternative, the flowchart of FIG. **10** may be viewed as depicting an example of steps of a method implemented in the computing device **203** (FIG. **2**) according to one or more embodiments.

Beginning with box **1003**, the images and/or data from the item imaging apparatus **100** (FIG. **1**) and/or the imaging control application **260** (FIG. **2**) may be accessed by the item processing system **223**. In box **1006**, optical recognition may be applied to the images to determine additional data that may have not been determined by the item imaging apparatus **100**. For example, optical recognition may be applied to all or a select portion of the images in order to determine any identifiable characters, text, symbols, and/or graphics. The optical recognition results may be used in determining a name, description, dimensions, weight, item type, category type, and/or any other information associated with the item **240** (FIG. **2**). For example, a label on an item **240** may state the weight of the item. The weight may accordingly be extracted from an image of the label. Similarly, the product name may appear in a larger typeset and the name of the item **240** may be extracted to be used as the name of the item **240** sold in the electronic marketplace **230** (FIG. **2**). The data extracted from the images may be compared to extraneous

data associated with the item **240** and/or may be compared to other data extracted from the images.

In box **1009**, a wireframe model of the item **240** may be generated based on the images and/or data obtained from the image. The wireframe model may be used in generating additional images of the item **240**, determining dimensions or other attributes **252** (FIG. **2**) corresponding to the item **240**, and/or may be used in determining the packaging of the item **240**. In box **1012**, a three-dimensional rendering **246** (FIG. **2**) of the item **240** may be generated. The three-dimensional rendering **246** may permit a user to manipulate the rendering in order to view all details of the item **240** on a xyz plane. In box **1015**, the data, three-dimensional renderings **246**, and/or images associated with the item **240** may be made available on an electronic marketplace **230**. For example, a product page corresponding to the item **240** may be generated and/or modified to include the three-dimensional rendering **246**, a portion of the images, and/or the data generated from the item processing system **223**. In box **1018**, permissions associated with the product page may be modified to permit a user to view the product page and/or to purchase the item **240** corresponding to the product page.

With reference to FIG. **11**, shown is a schematic block diagram of the computing device **203** according to an embodiment of the present disclosure. The computing device **203** includes one or more computing devices **203**. Each computing device **203** includes at least one processor circuit, for example, having a processor **1103** and a memory **1106**, both of which are coupled to a local interface **1109**. To this end, each computing device **203** may comprise, for example, at least one server computer or like device. The local interface **1109** may comprise, for example, a data bus with an accompanying address/control bus or other bus structure as can be appreciated.

Stored in the memory **1106** are both data and several components that are executable by the processor **1103**. In particular, stored in the memory **1106** and executable by the processor **1103** are the electronic commerce application **220** (FIG. **2**), the item processing system **223** (FIG. **2**), the imaging control application **260** (FIG. **2**), and potentially other applications. Also stored in the memory **1106** may be a data store **212** and other data. In addition, an operating system may be stored in the memory **1106** and executable by the processor **1103**.

It is understood that there may be other applications that are stored in the memory **1106** and are executable by the processor **1103** as can be appreciated. Where any component discussed herein is implemented in the form of software, any one of a number of programming languages may be employed such as, for example, C, C++, C#, Objective C, Java®, JavaScript®, Perl, PHP, Visual Basic®, Python®, Ruby, Flash®, or other programming languages.

A number of software components are stored in the memory **1106** and are executable by the processor **1103**. In this respect, the term "executable" means a program file that is in a form that can ultimately be run by the processor **1103**. Examples of executable programs may be, for example, a compiled program that can be translated into machine code in a format that can be loaded into a random access portion of the memory **1106** and run by the processor **1103**, source code that may be expressed in proper format such as object code that is capable of being loaded into a random access portion of the memory **1106** and executed by the processor **1103**, or source code that may be interpreted by another executable program to generate instructions in a random access portion of the memory **1106** to be executed by the processor **1103**, etc. An executable program may be stored in any portion or component of the memory **1106** including, for example, random access memory (RAM), read-only memory (ROM), hard drive, solid-state drive, USB flash drive, memory card, optical disc such as compact disc (CD) or digital versatile disc (DVD), floppy disk, magnetic tape, or other memory components.

The memory **1106** is defined herein as including both volatile and nonvolatile memory and data storage components. Volatile components are those that do not retain data values upon loss of power. Nonvolatile components are those that retain data upon a loss of power. Thus, the memory **1106** may comprise, for example, random access memory (RAM), read-only memory (ROM), hard disk drives, solid-state drives, USB flash drives, memory cards accessed via a memory card reader, floppy disks accessed via an associated floppy disk drive, optical discs accessed via an optical disc drive, magnetic tapes accessed via an appropriate tape drive, and/or other memory components, or a combination of any two or more of these memory components. In addition, the RAM may comprise, for example, static random access memory (SRAM), dynamic random access memory (DRAM), or magnetic random access memory (MRAM) and other such devices. The ROM may comprise, for example, a programmable read-only memory (PROM), an erasable programmable read-only memory (EPROM), an electrically erasable programmable read-only memory (EEPROM), or other like memory device.

Also, the processor **1103** may represent multiple processors **1103** and/or multiple processor cores and the memory **1106** may represent multiple memories **1106** that operate in parallel processing circuits, respectively. In such a case, the local interface **1109** may be an appropriate network that facilitates communication between any two of the multiple processors **1103**, between any processor **1103** and any of the memories **1106**, or between any two of the memories **1106**, etc. The local interface **1109** may comprise additional systems designed to coordinate this communication, including, for example, performing load balancing. The processor **1103** may be of electrical or of some other available construction.

Although the electronic commerce application **220**, the item processing system **223**, the imaging control application **260**, and other various systems described herein may be embodied in software or code executed by general purpose hardware as discussed above, as an alternative the same may also be embodied in dedicated hardware or a combination of software/general purpose hardware and dedicated hardware. If embodied in dedicated hardware, each can be implemented as a circuit or state machine that employs any one of or a combination of a number of technologies. These technologies may include, but are not limited to, discrete logic circuits having logic gates for implementing various logic functions upon an application of one or more data signals, application specific integrated circuits (ASICs) having appropriate logic gates, field-programmable gate arrays (FPGAs), or other components, etc. Such technologies are generally well known by those skilled in the art and, consequently, are not described in detail herein.

The flowcharts of FIGS. **9** and **10** show the functionality and operation of an implementation of portions of the imaging control application **260** and the item processing system **223**. If embodied in software, each block may represent a module, segment, or portion of code that comprises program instructions to implement the specified logical function(s). The program instructions may be embodied in the form of source code that comprises human-readable statements written in a programming language or machine code that comprises numerical instructions recognizable by

a suitable execution system such as a processor **1103** in a computer system or other system. The machine code may be converted from the source code, etc. If embodied in hardware, each block may represent a circuit or a number of interconnected circuits to implement the specified logical function(s).

Although the flowcharts of FIGS. **9** and **10** show a specific order of execution, it is understood that the order of execution may differ from that which is depicted. For example, the order of execution of two or more blocks may be scrambled relative to the order shown. Also, two or more blocks shown in succession in FIGS. **9** and **10** may be executed concurrently or with partial concurrence. Further, in some embodiments, one or more of the blocks shown in FIGS. **9** and **10** may be skipped or omitted. In addition, any number of counters, state variables, warning semaphores, or messages might be added to the logical flow described herein, for purposes of enhanced utility, accounting, performance measurement, or providing troubleshooting aids, etc. It is understood that all such variations are within the scope of the present disclosure.

Also, any logic or application described herein, including the electronic commerce application **220**, the item processing system **223**, and the imaging control application **260**, that comprises software or code can be embodied in any non-transitory computer-readable medium for use by or in connection with an instruction execution system such as, for example, a processor **1103** in a computer system or other system. In this sense, the logic may comprise, for example, statements including instructions and declarations that can be fetched from the computer-readable medium and executed by the instruction execution system. In the context of the present disclosure, a "computer-readable medium" can be any medium that can contain, store, or maintain the logic or application described herein for use by or in connection with the instruction execution system.

The computer-readable medium can comprise any one of many physical media such as, for example, magnetic, optical, or semiconductor media. More specific examples of a suitable computer-readable medium would include, but are not limited to, magnetic tapes, magnetic floppy diskettes, magnetic hard drives, memory cards, solid-state drives, USB flash drives, or optical discs. Also, the computer-readable medium may be a random access memory (RAM) including, for example, static random access memory (SRAM) and dynamic random access memory (DRAM), or magnetic random access memory (MRAM). In addition, the computer-readable medium may be a read-only memory (ROM), a programmable read-only memory (PROM), an erasable programmable read-only memory (EPROM), an electrically erasable programmable read-only memory (EEPROM), or other type of memory device.

It should be emphasized that the above-described embodiments of the present disclosure are merely possible examples of implementations set forth for a clear understanding of the principles of the disclosure. Many variations and modifications may be made to the above-described embodiment(s) without departing substantially from the spirit and principles of the disclosure. All such modifications and variations are intended to be included herein within the scope of this disclosure and protected by the following claims.

Therefore, the following is claimed:

**1**. A system, comprising:

at least one computing device;

an item imaging apparatus in communication with the at least one computing device configured to perform an imaging sequence where an item is imaged, the item imaging apparatus comprising:

a rotatable platform configured to support and rotate the item;

a scale assembly configured to measure a weight of the item;

a plurality of lights configured to illuminate the item; and

an imaging device capable of tilting and providing a plurality of zoom levels, wherein the imaging device is set on a curved pathway;

an actuator configured to move the imaging device along the curved pathway from a first position to a second position; and

program instructions executable in the at least one computing device that, when executed, cause the at least one computing device to perform a method comprising:

performing a pre-scan where a still image of a machine-readable identifier is captured using the imaging device to identify a type of the item, the type of the item being determined using the machine-readable identifier;

determining the imaging sequence to image the item from a plurality of potential imaging sequences stored in a data store based at least in part on the type of the item and a predetermined score indicating a degree of usability of the imaging sequence;

causing an automated performance of the imaging sequence, wherein the imaging sequence comprises:

varying a luminous intensity of the plurality of lights;

causing the actuator to move the imaging device along a path of the curved pathway, wherein at least a portion of the path is above the item;

rotating the rotatable platform; and

conducting a capture process by the imaging device that captures a plurality of images of the item as the imaging device is moved along the curved pathway; and

generating a three-dimensional rendering of the item based at least in part on the plurality of images.

**2**. The system of claim **1**, wherein the method performed by the at least one computing device further comprises applying an optical character recognition to at least one of the plurality of images to identify the type of the item.

**3**. The system of claim **1**, wherein the method performed by the at least one computing device further comprises programmatically modifying a permission associated with the item in response to the imaging sequence being performed to permit a product page for the item to become available that enables a purchase of the item through an electronic commerce system.

**4**. A system, comprising:

at least one computing device; and

an item imaging apparatus in communication with the at least one computing device, the item imaging apparatus comprising:

a platform to support an item;

a plurality of lights;

at least one imaging device set on a pathway; and

an actuator configured to move the at least one imaging device along the pathway from a first position to a second position; and

program instructions executable in the at least one computing device that, when executed, cause the at least one computing device to perform a method comprising:

capturing a representative image of the item during a pre-scan operation;

identifying a type of the item based at least in part on the representative image;

identifying an imaging sequence to image the item from a plurality of potential imaging sequences based at least in part on the type of the item and a predetermined score indicating a degree of usability of the imaging sequence; and

causing an automated performance of the imaging sequence using the at least one imaging device to generate a plurality of images of the item and data obtained from the plurality of images of the item.

**5**. The system of claim **4**, wherein the item imaging apparatus further comprises a scale configured to measure a weight of the item.

**6**. The system of claim **4**, wherein the imaging sequence comprises varying a luminous intensity of the plurality of lights.

**7**. The system of claim **4**, wherein the imaging sequence comprises causing the actuator to move the at least one imaging device from the first position to the second position along the pathway.

**8**. The system of claim **7**, wherein the imaging sequence comprises capturing the plurality of images of the item as the actuator moves the at least one imaging device from the first position to the second position.

**9**. The system of claim **7**, wherein the imaging sequence comprises rotating the platform as the actuator moves the at least one imaging device from the first position to the second position.

**10**. The system of claim **7**, wherein the imaging sequence comprises varying a zoom level of the at least one imaging device as the actuator moves the at least one imaging device from the first position to the second position.

**11**. The system of claim **4**, wherein the pathway is curved.

**12**. A method, comprising:

determining, by at least one computing device, an imaging sequence to apply to generate a plurality of images of an item and to obtain data from the item, the imaging sequence determined based at least in part on a type of the item identified during a pre-scan operation and a predetermined score indicating a degree of usability of the imaging sequence;

causing, by the at least one computing device, an automated performance of the imaging sequence in an item imaging apparatus, the imaging sequence comprising:

selectively illuminating a plurality of lights;

moving at least one imaging device along a pathway; and

capturing the plurality of images with the at least one imaging device as the at least one imaging device is moved along the pathway;

generating, by the at least one computing device, a description of the item based at least in part on the data;

generating, by the at least one computing device, a three-dimensional rendering of the item based at least in part on the plurality of images; and

generating, by the at least one computing device, user interface data comprising the description of the item and the three-dimensional rendering of the item.

**13**. The method of claim **12**, further comprising programmatically modifying, by the at least one computing device, at least one permission associated with the item in response to the imaging sequence being completed to cause an item page for the item to become available to view in an electronic commerce system.

**14**. The method of claim **12**, further comprising programmatically modifying, by the at least one computing device, at least one permission associated with the item in response to the imaging sequence being completed to cause an item page for the item to become available that facilitates a purchase of the item through an electronic commerce system.

**15**. The method of claim **12**, further comprising generating, by the at least one computing device, a three-dimensional wireframe model of the item based at least in part on the plurality of images.

**16**. The method of claim **15**, further comprising determining, by the at least one computing device, a plurality of dimensions associated with the item based at least in part on the three-dimensional wireframe model of the item.

**17**. The method of claim **12**, further comprising applying, by the at least one computing device, an optical character recognition to at least one of the plurality of images to generate the data.

**18**. The method of claim **17**, wherein the data comprises a plurality of characters associated with the item obtained from the optical character recognition.

**19**. The method of claim **12**, wherein the data comprises at least one optical identifier associated with the item obtained from at least one of the plurality of images.

**20**. The method of claim **12**, further comprising:

determining, by the at least one computing device, a score indicating a degree of usability of the three-dimensional rendering after the imaging sequence is performed; and

storing, by the at least one computing device, the score in association with the imaging sequence.

**21**. The method of claim **12**, further comprising:

determining, by the at least one computing device, a score indicating a degree of usability of the description after the imaging sequence is performed; and

storing, by the at least one computing device, the score in association with the imaging sequence.

**22**. The system of claim **1**, wherein the capture process is conducted by capturing the plurality of images of the item at a plurality of varying angles as the at least one imaging device is moved along the curved pathway.

**23**. The system of claim **3**, wherein the electronic commerce system is configured to generate user interface data that includes the three-dimensional rendering of the item, wherein the user interface data comprises a user interface component that permits a manipulation of the three-dimensional rendering to dynamically alter a viewing angle of the three-dimensional rendering in a user interface.

**24**. The system of claim **1**, wherein determining the imaging sequence to image the item from the plurality of potential imaging sequences further comprises applying a default imaging sequence in response to the type of the item not being identified.

**25**. The system of claim **3**, wherein the electronic commerce system is configured to generate user interface data that includes a plurality of properties of the item obtained from the imaging sequence, wherein the plurality of properties comprise at least one of: the weight of the item, a name of the item obtained from at least one of the plurality of images, a description of the item obtained from at least one of the plurality of images, a dimension of the item, and the type of the item.

**26**. The system of claim **1**, wherein the method performed by the at least one computing device further comprises

post-processing at least one of the plurality of images of the item to detect and remove an artifact from the at least one of the plurality of images.

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